

Physico-Chemical Analysis of Drinking Water in District Kohat, Khyber Pakhtunkhwa, Pakistan

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Abstract – This study was performed to examine the Physico-chemical analysis of water sources like Storage tank, Tube well and Tap water collected at sampling points of Shakardara, Lachi and Kohat city in district Kohat, Khyber Pakhtunkhwa, Pakistan and analyzed for the presence of various parameters like heavy metals, Sulphates, Nitrates, Nitrites, Chlorides, Total solids and Total soluble solids. Results indicated that some water samples had unacceptable level of ions and heavy metals as approved by World Health Organization (WHO). Magnesium, Calcium and Potassium were observed high from WHO standard in some samples. The concentration of Iron, Copper, Zinc, Manganese, Cadmium, Chromium and Lead were found below the WHO recommended guidelines.

Keywords – Physico-chemical parameters, drinking water, water sources.

1. Introduction

Safe drinking water is essential component to humans and other living beings for survival of life on earth, as water quality has direct impact on public health [1, 2]. According to WHO, 80% diseases in the world are caused by inadequate sanitation, pollution and unavailability of clean water [3]. During last decade, it has been observed that the ground water quality has changed and is getting drastically polluted due to physical, biological and chemical conditions [4, 5]. As a result of agricultural and anthropogenic activities like mining, ultimate disposal of toxic metals, human and animal faeces, industrial, domestic, municipal wastes and also the indiscriminate use of heavy metal chelates, fertilizers, pesticides and fungicides used in agriculture processes have resulted in deterioration of water quality rendering serious threats to human beings [6, 7]. Consequently number of cases responsible for mortalities and morbidities on a large scale caused by water borne diseases like typhoid, cholera, dysentery and diarrhea outbreaks [3]. Even if no sources of anthropogenic contamination exist there is potential for natural level of metals and other chemicals harmful to human health [8]. The natural water analysis for physical and chemical properties including trace element contents is very important for public health studies [9]. So basic monitoring on water quality has been necessitated to observe the demand and pollution level of ground water [10, 11]. Presently, in case of urban areas only 80% and in case of rural areas only 11% of the population has access to the piped water supply whereas in most of the areas the population is dependent on

irrigation water for their domestic needs rather than drinking water [12, 13]. In K.P.K the situation is still worse, where only about 50 % of the total population has access to proper water supply schemes [14]. The present study deals with study of physico-chemical analysis on ground-water in selected outlying areas of district Kohat. The analyzed data were compared with standard values recommended by WHO [15].

2. Materials and Methods

2.1. Materials

2.1.1. Equipment

Perkin-Elmer 3110 model Flame Atomic Absorption Spectrometer, Perkin-Elmer 400 model Atomic Absorption Spectrometer, pH meter [HI 8428, Hana], conductivity meter [PC m3-Jenway]

2.1.2. Chemicals

Double ionized distilled water, sulphuric acid, silver nitrate complex-metric EDTA, potassium chromate

2.2. Methods

2.2.1. Collection of Water samples

Water samples were collected in sterile bottles and labeled accordingly with representative of the supply source from selected area of interest at sampling points of Shakardara,

Lachi and Kohat city in District Kohat and analyzed promptly for various physico-chemical parameters

2.2.2. Analysis of Samples

The instruments were calibrated before analysis for each parameter. All the chemicals used for analysis were of analytical grade (Merck and BDH). All the stocks solutions were prepared with double ionized distilled water. pH of water was determined by using pH meter [HI 8428,Hana]. Conductance of water was determined using conductivity meter [PC m3-Jenway]. Total solids (TS), Total dissolved solids (TDS) and total suspended solids (TSS) were determined by using standards methods of American Public Health Association and WHO guidelines. [16]. Chlorides were estimated by titration method using silver nitrate (0.043N) as standard solution and potassium chromate as indicator. Alkali metals (Na and K) were determined by using

Flame Atomic Absorption Spectrophotometer Perkin-Elmer 3110. Determination of Iron (Fe), Zinc (Zn), Copper (Cu), Manganese (Mn), Lead (Pb), Chromium (Cr), Cadmium(Cd), Calcium(Ca), Magnesium (Mg), were carried out by using Flame Atomic Absorption Spectrophotometer Perkin-Elmer 400. Physical measurement and chemical analysis were carried out in triplicate for each sample and the average values were recorded.

3. Results and Discussion

All the measurements comprising of various parameters obtained from the results showed substantial variations from sample to sample carried out in the vicinity of room temperature to ascertain the contamination levels of drinking water from different sources. Results are tabulated also shown by graphical representation (Graphs 1-3).

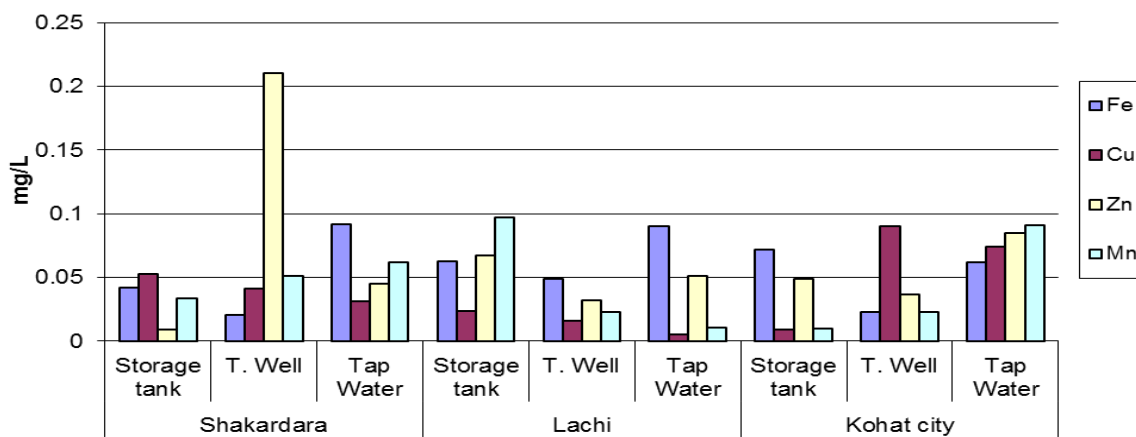


Figure 1. Showing level of essential elements

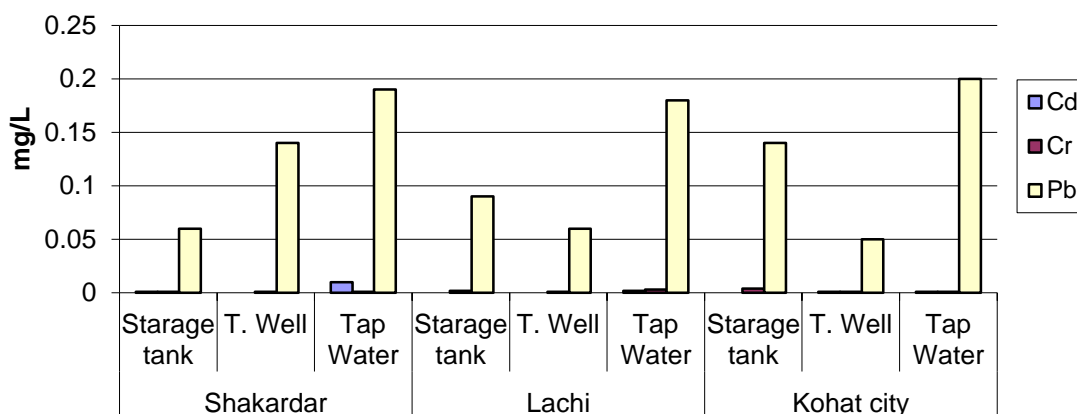


Figure 2: Showing level of toxic elements

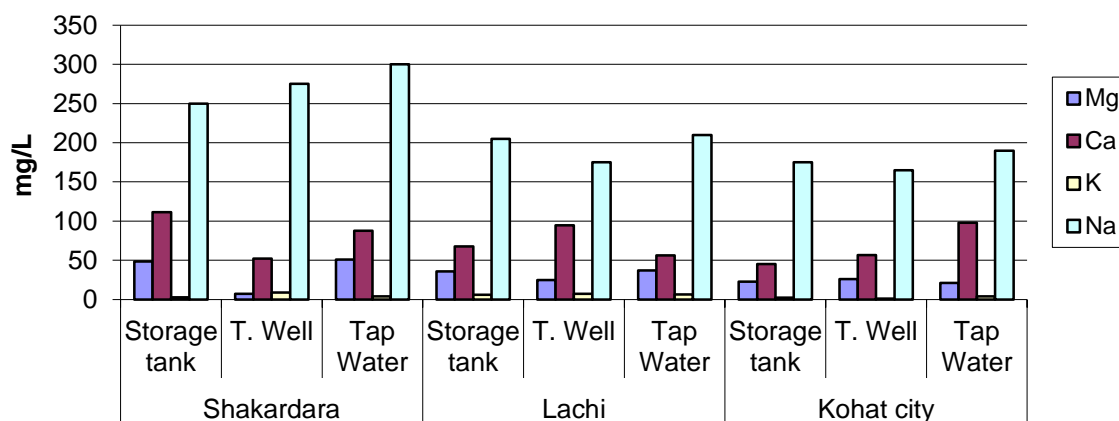


Figure 3: Showing level of mineral elements

Color, taste and odor are the direct investigative of contaminations. According to World health organization the drinking water should be colorless, odorless and tasteless. An organoleptic observation showed that one sample of tap water from Shakardara was found to have objectionable taste whereas rests of samples were found to

be colorless, odorless and tasteless. The pH is one of the essential parameter of drinking water which shows the acidic or basic nature. According to declaration of World health organization [15] standards, pH value must be in range of 6.5-8.5. Table 1 shows that pH in selected water samples varied in the range of 7.9-8.5 (WHO. 2004).

Table 1. Showing various Physico Parameters

Location	Source	Temp. °C	pH	SD*	E.C** (µS/cm)	SD*
Shakardara	Storage tank	25.8	8.4	0.047	760	4.11
	Tube Well	26.3	8.3	0.032	970	5.01
	Tap Water	28.6	8.5	0.021	2300	16.10
Lachi	Storage tank	26.5	8.2	0.023	546	13.98
	Tube Well	26.9	8.1	0.056	595	3.24
	Tap Water	27.1	7.9	0.057	885	3.67
Kohat city	Storage tank	24.2	8.0	0.020	345	5.09
	Tube Well	24.0	8.3	0.010	385	4.10
	Tap Water	24.4	8.2	0.03	490	3.20

SD* means Standard deviation, E.C**: Electrical conductivity

Electrical conductivity (E.C) actually measures the level of the salts ion in water. The high value of electrical conductivity observed in the range between 345- 2300 µS/cm shows the presence of major cations and anions. The WHO permissible limit of E. C is 400µS/cm. All samples except storage tank and tube well water of Kohat city showed high Electrical conductivity. Though some of the metals like Cu, Fe, Mn, Ni and Zn are essential as micronutrients for life processes in plants and microorganisms, yet many others like Cd, Cr and Pb have no known physiological activity and are proved to be detrimental beyond a recommended limit [17]. Therefore, monitoring of these metals is important for safety assessment of the environment and human health in particular [18]. Table 2 shows the level of various elements like iron, copper, zinc, manganese, cadmium, chromium, lead, magnesium, calcium, potassium and sodium analyzed in drinking water of selected areas. Different elements showed different concentrations range

as Fe was found in the range of 0.021-0.092 mg/L, Cu: 0.005-0.090mg/L, Zn: 0.009-0.210mg/L, Mn: 0.010-0.097mg/L. Cadmium was found below the detection level in 4 samples of drinking water and in other samples it was 0.001mg/L. According to WHO, the permissible limit of Fe, Cu, Zn, Mn and Cd in drinking water are 0.3, 2.0, 5.0, 0.5 and 0.003mg/L respectively. It is clear from the results that Fe, Cu and Zn in all the selected samples were found below the permissible limit as prescribed by WHO. Similarly the minimum and maximum ranges of Cr and Pb in drinking water are 0.001-0.004mg/L and 0.06-0.20mg/L respectively. Calcium and magnesium are an important minerals present in the earth crust and natural water that form highly soluble salts. Table 2 shows that concentrations of Mg, Ca, K and Na in the samples were in the range of 121.1-229.1, 45.2-111.6, 6.2-18.9 and 165-300mg/L respectively. The WHO permissible limit of Mg is 150mg/L, Ca: 75mg/L, K: 12mg/L and that of Na is 200mg/L. It is clear from the results that Mg was found

high in two samples of Shakardara and Lachi whereas below the WHO guidelines in the samples collected from Kohat city. Calcium was above the WHO standards in the

samples of all the selected spots. The level of Potassium in the water samples of Shakardara and Lachi was above the limit as prescribed by WHO. It can be seen from table 2

Table 2. Showing level of essential, toxic and mineral elements (mg/L) in Drinking Water

Elements	Shakardara			Lachi			Kohat city		
	Storage tank	Tube Well	Tap Water	Storage tank	Tube Well	Tap Water	Storage tank	Tube Well	Tap Water
Iron	0.042	0.021	0.092	0.063	0.049	0.090	0.072	0.023	0.062
Copper	0.053	0.041	0.031	0.024	0.016	0.005	0.009	0.090	0.074
Zinc	0.009	0.210	0.045	0.067	0.032	0.051	0.049	0.037	0.085
Manganese	0.034	0.051	0.062	0.097	0.023	0.011	0.010	0.023	0.091
Cadmium	0.001	BDL	0.01	BDL	BDL	0.002	BDL	0.001	0.001
Chromium	0.001	0.001	0.001	0.002	0.001	0.003	0.004	0.001	0.001
Lead	0.06	0.14	0.19	0.09	0.06	0.18	0.14	0.05	0.20
Magnesium	148.6	229.1	181.0	155.9	124.8	187.2	123.0	125.9	121.1
Calcium	111.6	52.01	87.9	67.9	94.5	56.3	45.2	56.5	68.1
Potassium	11.79	18.9	14.2	15.9	17.3	16.3	8.5	7.3	6.2
Sodium	250	275	300	205	175	210	175	165	190

BDL=Below Detection Limit

that all the three selected samples of Shakardara contain high level of Na than the WHO recommended standards. In Lachi, two samples were recorded having concentration greater than WHO recommended level. Table 3 shows the different analyzed parameters in drinking water like nitrite, nitrate, sulphates, chlorides, total solids, total dissolved solids and total suspended solids. The range of nitrate and

nitrite in the analyzed drinking water was noted to be 2.02-7.8 and 0.05-0.14mg/L respectively. The nitrite and nitrate values were observed below the WHO safe guideline for drinking water. The range of sulphates and chlorides occur in drinking water 145-301mg/L and 468-766 mg/L while the range of TS, TDS and TSSs were recorded to be 548-2155mg/L, 1540-2256mg/L and 10-20mg/L respectively.

Table 3. Showing various parameters in Drinking Water (mg/L)

Location	Source	Nitrate	Nitrite	Sulphates	Chloride	TS	TDS	TSS
Shakardara	Storage tank	7.8	0.09	301	730	2155	2016	20
	Tube well	5.01	0.14	145	650	950	2256	12
	Tap water	6.03	0.08	201	766	1059	1687	13
Lachi	Storage tank	4.02	0.07	275	570	860	1780	14
	Tube well	2.02	0.11	170	469	1480	1590	12
	Tap water	5.12	0.12	145	642	678	1540	13
Kohat city	Storage tank	6.10	0.06	163	734	548	1890	10
	Tube well	7.23	0.05	180	864	987	1780	12
	Tap water	4.34	0.09	169	468	654	1690	11

4. Conclusion

After investigating and comparing different parameters with WHO guidelines, this study revealed that drinking water has been found contaminated in Shakardara, Khyber Pakhtunkhwa, Pakistan and it was concluded that ground

water in Shakardara and Lachi showed more contamination as compared to Kohat city. It may be due to nearby high amount of minerals and salt ranges. Thus water should be checked for these contaminants before using for drinking, domestic and other sensitive purposes.

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